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The evaluation of the febrile patient

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THE EVALUATION OF THE FEBRILE PATIENT

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THE EVALUATION OF THE FEBRILE PATIENT

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I would like to thank Dr. Richard V. Lee and Dr. Walter Hierholzer for their help, advice, encouragement, and understanding-and most of all-for their senses of humor.

This thesis is dedicated to my parents, my sister, Philip Mintz, Hanni and Al Schwerdt, and to all my friends and teachers, without whom I would never have made it to the point of having to write a thesis.

PREFACE

How necessary is a paper on the evaluation and treatment of fevers at a major university medical center? Ask any third year medical student, "How would you work up a fever?" Most would preface their responses, "And what service am I supposed to be on?" Such an answer immediately raises several questions. Is there a difference in the manner in which physicians of the medicine, surgery, pediatrics, and gynecology departments approach the patient with fever? Should there be such a difference, if one in fact exists? Do the various services see totally different types of fevers and patients? This thesis was initiated, with the approval of the Human Investigation Committee, to attempt to answer these questions.

INTRODUCTION

What is fever?

Although perhaps the "ritual of temperature taking has been surpassed only by Alexander Graham Bell's invention of 1874 as the major curse of pediatrics" (Smith, 1970) fever itself may be defined as "an elevation of body temperature due to disease." (Atkins, 1970) In a hospital setting

> it will be noticed that the trained staff never assume that the fever is due to an extraneous condition, such as cold, or that it is of no importance. The cause must be found, since a rise in temperature may be the first indication of a complication that will delay recovery and may even threaten life. (Hector, 1968)

Specialists in all fields of medicine ascribe importance to fever. Surgeons are told in their most basic text that "albeit nonspecific, fever and tachycardia are additional signs of infection." (Schwartz, 1969) "Relative temperature and pulse rate increases" are the "most useful signs of post-operative bacterial sepsis." (Feller, 1972) Among the pediatric population, studies have shown that fever is the most common clinical sign of septicemia in all but children under six months of age. (Hanninen, 1971) Internists are told that "fever is by far the most common sign in infective endocarditis." (Weinstein, 1973)

Perhaps, then, most people in medicine would agree that it is of at least some importance to recognize a fever. The next question to define, though, is "What constitutes a fever?" In most publications, we are not told what the author is calling a fever. Even when a fever cutoff point

is mentioned, few authors state whether they are recording oral, rectal, or even axillary temperatures (Habel, 1972; Jansson, 1971; Hanninen, 1971); 98.6°F may well be normal oral temperature, but it is one degree lower than normal rectal temperature, and one degree higher than axillary temperature. (Macbryde, 1970) Nelson's Textbook of Pediatrics calls 100°F an elevation in temperature, (Nelson, 1969) while Cone found that 50% of supposedly normal 18 month olds in his study had rectal temperatures of 100°F or higher. (Cone, 1969) In one study of febrile children in a walk-in pediatric clinic in Boston, fever was defined as a rectal temperature of 38.3°C or higher, oral temperature of 37.8°C or higher. (McGowan, 1973) Petersdorf has called 97°F to 99.2°F normal. (Petersdorf, 1968) Perhaps the widest definition of the normal range takes into account that the median temperature of a normal population is 98.6°F and that the standard deviation of temperatures of such a population is 0.6°F. By such a definition, a temperature outside the range of 97.0°F to 100.4°F (orally) is abnormal. (Atkins, 1970)

Approach to fever

Presuming then that there is at least some definable level at which a temperature may be considered elevated, and that such an elevation may be important to the patient, what should be done about it? Probably the most thorough guidelines are offered by Feller, in evaluating the patient with possible post-operative sepsis. (Feller, 1972) He

suggests that one first evaluate the patient's pulmonary status by physical examination and chest xray. The next step is review of the pre- and post-operative urine cultures. The most recent change in intravenous and urinary catheters should then be checked, and intravenous sites should be checked for septic phlebitis. The wound and drains should be checked. He suggests thorough review of the patient's medical history, looking especially for history of diseases such as rheumatic fever, with special note to previous therapy. He then advises that one obtain cultures: two blood cultures, and wound, tracheal, nasopharyngeal, and fecal cultures. He notes that if there is any question of central nervous system involvement, lumbar puncture should be performed. He does not recommend per oral sputum cultures, but does recommend obtaining a white blood cell count.

Therapeutically, Feller recommends changing intravenous and urinary catheters, suctioning the lungs if congested, and opening and draining abscesses. He advocates use of specific antibiotics, but advises treating the fever itself with antipyretic measures only if it is "greater than 104^{o}F to prevent central nervous system damage."

Many authors agree with Dr. Feller's vigorous approach to the possible bacteremic patient. "Blood cultures should be done at the slightest indication because a positive result is extremely helpful," comments one (Dineen, 1972) while multiple cultures (from three to five) are indicated if any are to be done at all, notes another. (Dalton, 1967)

Even a less aggressive approach during the post-operative period calls for a white blood cell count and differential count, urinalysis and chest xray, in addition to bacterial studies of urine, blood, and wound drainage. If pulmonary complications are noted, the sputum should be examined for signs of blood and/or bacteria. (Wise, 1963)

Some physicians, however, feel that in the immediate post-operative period fever per se is not an omen of impending doom. One gynecological surgeon has dismissed temperature elevations of up to 101°F during the first three post-operative days as without consequences. (Porges, 1970)

Guidelines for internists and pediatricians are less specific. Whereas greater numbers of surgical and obstetrics and gynecology patients acquire nosocomial infections, (Eickhoff, 1969) community acquired infections are seen more often on non-surgical services. (Barrett, 1968) Some pediatricians advocate complete culturing of materials "from the system of the body chiefly involved" giving special consideration to portals of entry, while obtaining more than one culture when seeking causative pathogens. (Nelson, 1969) Others, noting that most febrile illnesses in children are caused by viruses, economically apply Sutton's Law* to deplore the tendency to carry out a battery of routine examinations in a "conventional sequence." (Cone, 1969) Medical people

*"Willie Sutton, a hold-up man... was asked why he always robbed banks. Sutton...replied, "Why, that's where the money is.'" (Petersdorf, 1961)

are rarely guided by any advice more specific than to do the "usual laboratory studies made initially to identify the cause of a febrile illness, examples being bacteriological and serologic tests, radiologic examinations, skin tests, etc." (Petersdorf, 1961) Occasionally a number is mentioned, as when Dr. Weinstein allows six to ten blood cultures as probably adequate to diagnose endocarditis (Molavi, 1970) but such numerical guidelines are rarely set forth.

How, then, are fevers approached at a major university medical center?

MATERIALS AND METHODS

For a period of one month, the investigator daily surveyed six wards at an 878 bed university medical center. The units surveyed consisted of (1) a 24 bed university service medical ward; (2) a 30 bed private service medical ward; (3) a 30 bed university service surgical ward, serving general, orthopedic, and peripheral vascular surgical patients; (4) a 30 bed private service surgical ward, serving both general and orthopedic surgery patients; (5) a 27 bed pediatric ward, with both private and university service patients, ranging from one to fifteen years of age; (6) a 29 bed gynecology ward, including both private and university service patients, several of whom were receiving radium therapy. The gynecology service was surveyed for a two month period to obtain a sample with a number of patients comparable to the other services. No intensive care unit patients were included in this study. No prior cooperation of house staff

or nursing staff was obtained.

The investigator visited each floor daily during the surveillance period, checking the vital sign data sheets, henceforth referred to as day sheets, of each patient on each floor. The vital signs of patients were taken at different frequencies on the same floor, the frequency being individualized per patient. The investigator recorded the name and the hospital unit number of every patient whose temperature on any one occasion reached or exceeded 100.4°F orally or 101.4°F rectally. The total number of admissions to the floor was also recorded each day.

Data tabulation

After the patients were discharged, the investigator inspected the charts of all febrile patients. The following information was recorded on separate data sheets for each patient. (Figure 1)

1. Service: patient's ward and hospital service.
2. Insurance: type of insurance, e.g., private insurance carrier, Title 19, etc.
3. Name: patient's name, age, and sex.
4. Admission diagnoses: obtained from intern's or resident's admission note.
5. Admission and discharge dates: obtained from title sheet for each admission.
6. Fever date: the first date during the observation period on which the patient's temperature exceeded the stated limits, as taken from the day sheets. If the

FIGURE 1 Data Sheet

VICE: _____ INSURANCE: _____

: _____ AGE: _____

SSION DIAGNOSES: _____

SSION DATE: _____ DISCHARGE DATE: _____

ER DATE: _____ DURATION OF FEVER: _____

ST NOTED IN PROGRESS NOTES: _____ DELAY: _____

EST TEMPERATURE: 100.4-101.9 _____ 102-103.9 _____ 104+ _____

	INITIAL			FOLLOWUP
KUP :	YES	NO	NUMBER	
TMENT ON FEVER:				
YSICAL EXAM				
LTURES				
BLOOD				
URINE				
SPUTUM				
CSF				
OTHER				
ER LAB STUDIES:				
BC				
DIFFERENTIAL				
SR				
A				
TYPE				
METER CHECK:				
V				
OLEY				
S:				
CXR				
OTHER				
ATIENT:				
NTIPYRETIC:				
NTIBIOTIC:				
OPHYLACTIC ANTIBIOTICS:				
SULT REQUESTS:				
FECTIOUS DISEASE				
TH R				

patient was febrile on the first day of the study, the onset of the patient's fever was noted, even if it began before the observation period.

7. Duration of fever: the febrile episode was considered to last until followed by a 48 hour period during which the patient's temperature did not reach 100.4°F orally or 101.4°F rectally. If the patient's temperature again reached these limits after 48 afebrile hours, he or she was considered to have developed a new fever, and a new information sheet was started to collect information on that separate fever.
8. First noted in progress notes: the date on which it was first recorded in the doctor's progress notes that the patient had a fever.
9. Delay (in recording of observation): the duration of time between the development of fever (from the day sheets) and the first notation in the doctor's progress notes.
10. Highest temperature: highest temperature recorded orally (rectal temperatures interpreted as one degree higher than oral temperatures) during each febrile episode.
11. Comment on fever: whether or not the patient's physicians also commented on the fever, as to probable origin, seriousness, etc.
12. Physical exam: if three or more of the following observations: throat, heart, lungs, abdomen, and extremities

were recorded as having been examined, the exam was considered complete.

13. Cultures: cultures obtained during each febrile episode were recorded. As culture reports do not always appear in the chart, the investigator also checked the records of the bacteriological laboratories as to the number, date, and source of specimens for culture received for each febrile patient. Since many cultures are reported in the progress notes as ordered for a patient but are never sent to the microbiology labs, these were not considered evidence for a culture having been taken.
14. Other lab studies: as laboratory slips from the clinical microscopy laboratory return to the patient's chart promptly, the appearance of such a slip in the chart was considered the only evidence that such a test had been performed. Total number of blood counts and urinalyses was not recorded.
15. Catheter check: the presence of an intravenous drip was noted from either the patient's day sheet (where parenteral intake is recorded) or from nurses' notes, which usually comment on the functioning of an intravenous line. The presence of a Foley catheter was similarly ascertained. This method of notation may not detect all catheters. (Hierholzer, personal communication) "Catheter check" was defined by a culture of an intravenous catheter, or by a comment in the progress notes that the catheter site had been inspected. "Foley catheter check" was defined

as a urine culture.

16. Xrays: only xrays ordered during the febrile episode were recorded. Either a radiological report or report in the progress notes of the xray results was considered evidence of the performance of such a test. Only xrays ordered for workup of the fever were recorded. For example, a chest xray ordered for determination of placement of a central venous pressure line was not considered to have been ordered as part of the fever workup.
17. Treatment: medications given to the patient during each febrile episode were recorded. This information was obtained from the patient's treatment sheet. Anti-biotic and anti-pyretic usage were noted.
18. Consult requests: all infectious disease consults were noted. Any other consult requested for the patient was considered germane to the fever workup only if so noted in the consult request.

Any aspects of the workup which seemed in some way remarkable to the investigator were noted.

The results on differences among various services, pertaining to observation of fever, delays in observation, ordering of various tests, catheter checks, consult requests, and treatment will be presented below.

RESULTS

Of the 690 patients included in this study, 196 were on adult surgical services, 203 on medical services, 154 on

gynecological services, and 137 on pediatric services. (See Figure 2.) The numbers of those patients admitted to each floor during the observation period are also noted, to enable calculation of the incidence and prevalence of fevers occuring. Incidence here indicates the development of fever in patients admitted to the various services during the observation period, whereas prevalence indicates the number of fevers existing in all patients on the various services during that period. The prevalence and incidence of fevers occuring on the various services are as noted in Figures 2 and 3. There is no significant difference in the prevalence of fevers on the various services, as calculated by a chi square test applied to a 2 x 4 contingency table. (Snedecor, p. 238, 1967) (All further statistical analyses will be by chi square method, unless otherwise stated.) However, the inter-service differences in incidence of fever were significant ($p < .025$).

Eleven of the charts of the 213 patients who developed fevers were subsequently unavailable for study, and the remaining data to be presented comes from 202 of the study patients. Unavailable charts include those of four medical, three surgical, three gynecological, and one pediatrics patient.

The average age of the surgical patients was 51.4 years; that of medical patients 60.6 years; that of gynecological patients 48.2 years; and that of pediatric patients 6.6 years. Of the medical patients, 23 were male, 27 female;

FIGURE 2 Prevalence of fever

Service	Febrile patients	Total patients	Prevalence of fever
Surgery	72	196	36.8%
Medicine	54	203	26.6%
Gynecology	40	154	26.0%
Pediatrics	47	137	34.3%
Total	213	690	30.9%

FIGURE 3 Incidence of fever

Service	Fever among new patients	New admissions during study	Incidence of fever
Surgery	58	145	40.0%
Medicine	35	149	23.5%
Gynecology	39	141	27.6%
Pediatrics	37	117	31.6%
Total	169	552	30.6%

of pediatric patients, 27 were male, 19 female; and of surgical patients, 43 were male, and 26 female.

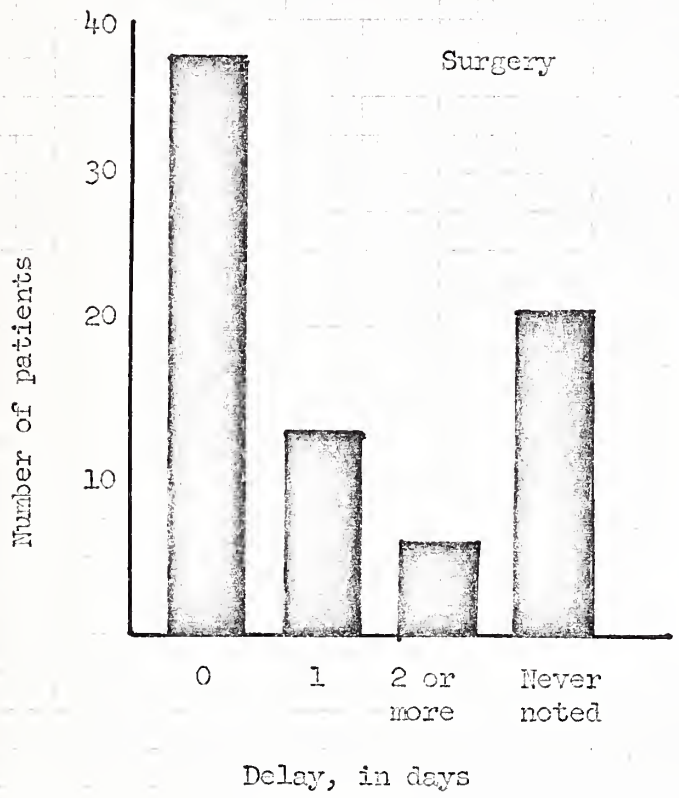
Fever was considered community acquired if it occurred on the day of admission. 25, or 37% of surgical patients had such fevers. 22, or 45% of medical patients; 4, or 11% of gynecological patients, and 13, or 29% of pediatric patients, had such community acquired fevers. Such differences among services are significant ($p < .01$).

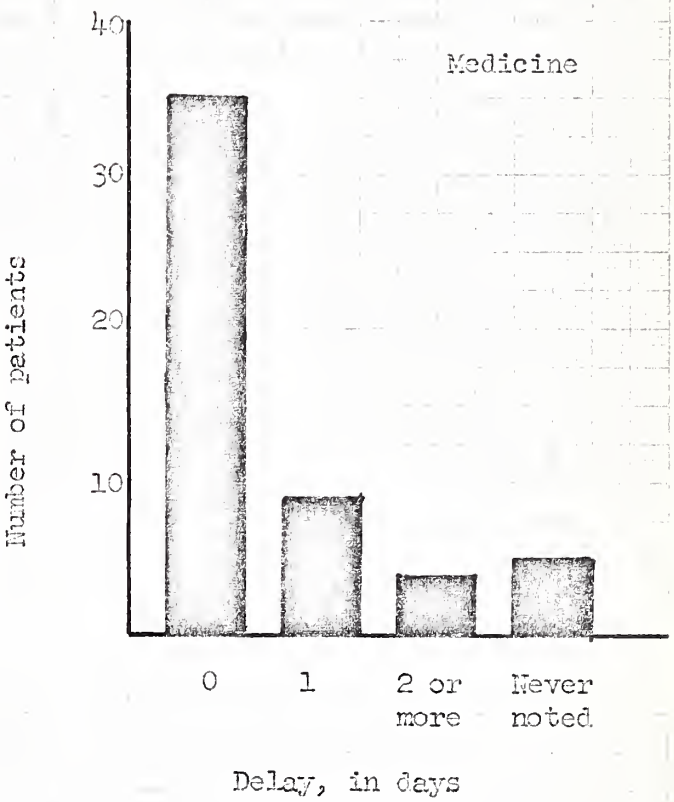
Not all fevers that occurred as observed from day sheets were recorded in the progress notes. On the surgical services, 21 of 77 fevers (27%) were never noted; 5 of 53 (9.4%) medical patients' fevers were never noted; 4 of 39 gynecological patients' fevers (10%) went unnoted; and 18 of 48 pediatric patients' fevers were not noted in doctor's progress notes. These differences are also significant ($p < .01$).

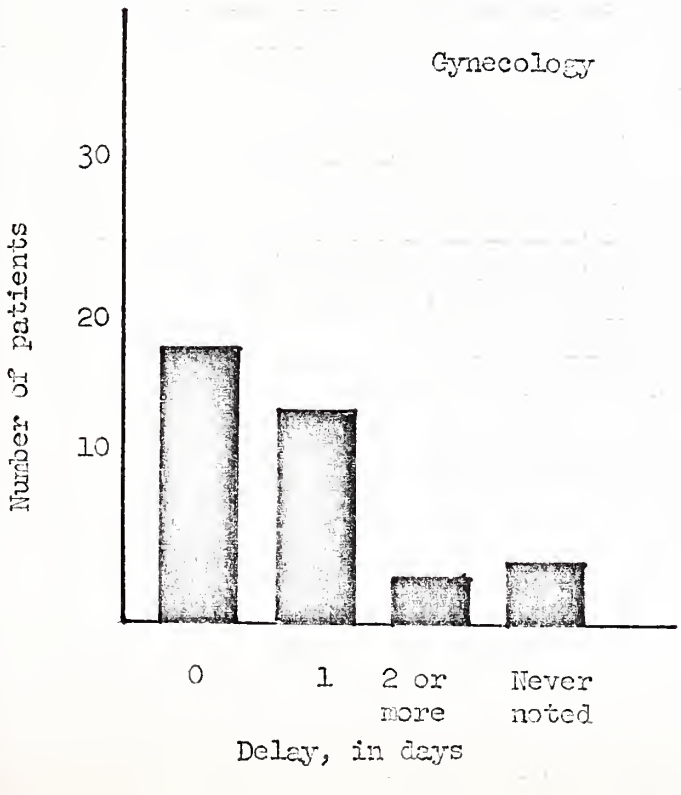
Delay in recognition of fevers, of those fevers which were noted, did not differ significantly from service to service. The average delay in noting a fever in the progress notes was 0.43 days (ranging from 0 to 2) on the surgical services; 0.28 days (ranging from 0 to 5) on the medical services; 0.64 days on the gynecological service (range, from 0 to 4); and 0.59 days on the pediatric service (range, from 0 to 4). (See Figure 4).

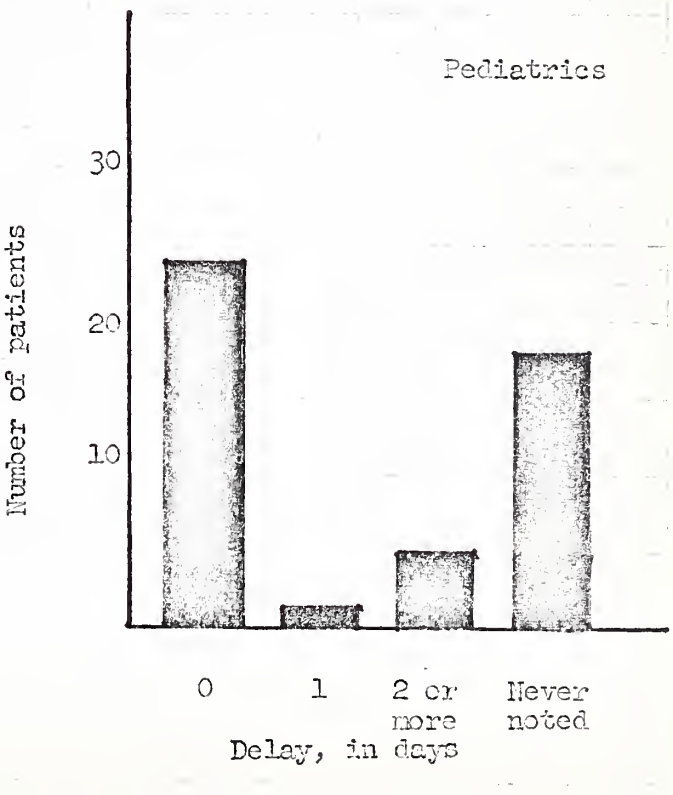
One question that is often raised is that do patients who enter with fevers receive more thorough fever workups than those patients who develop fever in hospital. Such was the case on the pediatric service, where significantly more fevers were noted in the charts and cultures drawn for

Figure 4 Delay in Recognition of Fever









patients with community acquired as opposed to nosocomial fevers. (See Figure 5.) On the surgical service, the fevers of patients who entered the hospital with fever were more frequently noted than those which developed in hospital, however, the difference in obtaining cultures is non-significant. On both the medical and gynecological services, there were no significant differences in the noting of fevers or the ordering of cultures for the patients with community and hospital acquired fevers.

As there were many patients whose fevers were never commented upon in the progress notes, it is important to see if these are in fact different types of patients, and if these two groups, that is, those whose fevers are noted and those whose fevers are not noted, are managed differently.

On the surgical services, 56 patients developed fevers which were noted; 21 of the patients' fevers went unnoted. The average duration of fever in patients whose temperatures were noted to be elevated was 5.3 days (range, 1 to 48 days); among those whose fevers were not noted the average fever duration was 1.9 days (range, 1 to 5 days). Such a difference was significant ($p < .025$) by t-test analysis (Snedecor, p. 105, 1967) (test necessary to compare the means of two groups of unequal sizes). Of the 21 unnoted fevers, all reached a peak of less than 102°F (orally), whereas 20 of the 56 fevers noted in the doctor's progress notes reached or exceeded 102°F. (See Figure 6) Such a difference is significant. The two patient populations were worked up differently. Of the 21 patients with unnoted fevers, cultures

FIGURE 5 Comparison of community and hospital acquired fevers

		Community acquired fevers	Hospital acquired fevers
Surgery	Fever noted	22	34
	Fever not noted	3	18
Medicine	Fever noted	21	27
	Fever not noted	1	4
Gynecology	Fever noted	4	31
	Fever not noted	0	4
Pediatrics	Fever noted	13	16
	Fever not noted	0	18

		Community acquired fevers	Hospital acquired fevers
Surgery	Cultures taken	18	31
	Cultures not taken	7	21
Medicine	Cultures taken	20	27
	Cultures not taken	2	4
Gynecology	Cultures taken	4	27
	Cultures not taken	0	8
Pediatrics	Cultures taken	12	12
	Cultures not taken	1	22

of any sort were taken from 6, whereas of those 56 whose fevers were noted, 43 had cultures taken. This difference is likewise significant to the .005 level. Similarly, 15 of the 21 had any other sort of diagnostic test (white blood cell count, urinalysis, xray) done during their febrile episodes; 54 of the 56 patients with noted temperatures received some sort of diagnostic test. This is also significant to the .005 level. These two groups of patients also received different antibiotic therapy during the febrile episode; 32 of the patients with noted fevers received antibiotics, while of the 21 with uncommented upon temperature elevations, only 5 received antibiotic therapy. These differences are also significant ($p < .025$).

FIGURE 6 Comparison in workup of fevers noted and not noted in progress notes by the surgery service

	Fevers noted in progress notes	Fevers not noted in progress notes
Temperature $< 102^{\circ}F$	36	21
Temperature $\geq 102^{\circ}F$	20	0
Cultures taken	43	6
Cultures not taken	13	15
Diagnostic tests ordered	54	15
Diagnostic tests not ordered	2	6
Antibiotics-yes	32	5
Antibiotics-no	24	16

Such calculations were done for the other services as well. 5 of the 53 fevers which occured on the medical service went unnoted; 48 then were noted. The average duration of fever was 6.4 (ranging from 1 to 33) days in the group with noted temperature elevations; it was 1.8 (ranging from 1 to 4) days among the group whose fever was not noted. This difference was not significant ($p > .10$). The difference in the proportion of fevers reaching 102°F orally was not significant, nor was there a significant difference in antibiotic coverage between the two groups. However, a significantly higher proportion of patients with noted fevers received cultures. (See Figure 7.)

FIGURE 7 Comparison in workup of fevers noted and not noted in progress notes by the medical service

	Fevers noted in progress notes	Fevers not noted in progress notes
Temperature < 102°F	24	4
Temperature ≥ 102°F	24	1
Cultures taken	45	2
Cultures not taken	3	3
Diagnostic tests ordered	48	4
Diagnostic tests not ordered	0	1
Antibiotics-yes	31	2
Antibiotics-no	17	3

Of the gynecological patients, there was no significant difference in the proportion of patients with noted and unnoted temperature elevations greater than 102°F nor was there a significant difference in antibiotic treatment between the two groups. However, differences between the two groups in proportions of patients for whom cultures and diagnostic tests were ordered were statistically significant. (See Figure 8.)

FIGURE 8 Comparison in workup of fevers noted and not noted in progress notes by the gynecological service

	Fevers noted in progress notes	Fevers not noted in progress notes
Temperature $<102^{\circ}F$	24	4
Temperature $\geq 102^{\circ}F$	11	0
Cultures taken	30	1
Cultures not taken	5	3
Diagnostic tests ordered	32	2
Diagnostic tests not ordered	3	2
Antibiotics-yes	20	1
Antibiotics-no	15	3

On the pediatric service, 18 of the fevers were not recorded in the doctor's progress notes; 29 were. The average duration of fever in the group whose fevers were noted was 4.4 days (range, 1 to 30 days); the average duration in the unnoted group was 2.2 days (range, 1 to 7 days), difference

not significant by t-test. However, the difference in proportion of patients whose fevers were 102°F or higher was significant ($p < .025$) between the two groups. The smaller proportion of patients for whom cultures were ordered in the unnoted group was significant ($p < .025$), as was the smaller proportion in the unnoted groups for whom diagnostic tests were ordered ($p < .05$). The differences in antibiotic usage were not significant. (See Figure 9.)

FIGURE 9 Comparison of workup of fevers noted and not noted in progress notes by the pediatrics service

	Fevers noted in progress notes	Fevers not noted in progress notes
Temperature < 102°F	22	18
Temperature ≥ 102°F	7	0
Cultures taken	19	5
Cultures not taken	10	13
Diagnostic tests ordered	23	9
Diagnostic tests not ordered	6	9
Antibiotics-yes	14	4
Antibiotics-no	15	14

As a result of the above data one may also ask if there is a difference in the handling of fevers below 102°F or higher than 102°F. (See Figure 10.) This difference does seem to exist on some of the services sampled in this study.

On the medical, surgical, and pediatric services, cultures were taken from significantly more patients febrile to 102°F or higher than from patients whose temperatures never reached 102°F.

FIGURE 10 Comparison of workups of fevers above and below 102°F

		Temperature < 102°F	Temperature ≥ 102
Surgery	Cultures taken	32	17
	Cultures not taken	25	3
Medicine	Cultures taken	22	25
	Cultures not taken	6	0
Gynecology	Cultures taken	20	11
	Cultures not taken	8	0
Pediatrics	Cultures taken	17	7
	Cultures not taken	23	0

Workup of fever

The next set of results deals with a comparison among the different services as to how they work up their patients whom they recognize as having fevers. Figures 11 through 14 show the numbers of patients for whom different cultures were ordered. Services were then compared using 2 x 4 contingency tables to demonstrate any significant differences in ordering cultures. The two groups established for comparison were the number of patients for whom no cultures (of each type) were ordered, compared to the number for whom one or more cultures were ordered.

The proportions of febrile patients who received one or more blood cultures were: medicine, 90%; surgery, 46%; gynecology, 23%; and pediatrics, 52%. Such inter-service differences were significant ($p < .005$). As many experts advocate the use of two blood cultures, the proportions of patients receiving less than two and two or more cultures were computed. Percentages of patients receiving two or more blood cultures were: medicine, 81%; surgery, 29%; gynecology, 11%; pediatrics, 28%. These inter-service differences are also highly significant ($p < .005$).

Similar differences in workup can be noted in obtaining other cultures for patients with fevers recorded in the doctor's progress notes. One or more urine cultures were ordered for 85% of medical patients, 55% of surgical patients, 80% of gynecological patients, and 52% of pediatric patients. Such differences are significant at the .005 level. All services in general seemed to order fewer sputum cultures. 67% of medical, 32% of surgical, 6% of gynecological, and 14% of pediatric patients whose fevers were noted had sputum cultures ordered. Inter-service percentage differences are again significant ($p < .005$).

All other cultures ordered (CSF, wound, throat, nasopharyngeal, rectal, cervical, etc.) were grouped in the "other" category. These cultures were presumably special cultures ordered for specifically questioned possibly infected areas. In this category as well there were significant ($p < .01$) differences among services, with medicine

FIGURE 11 Blood Cultures

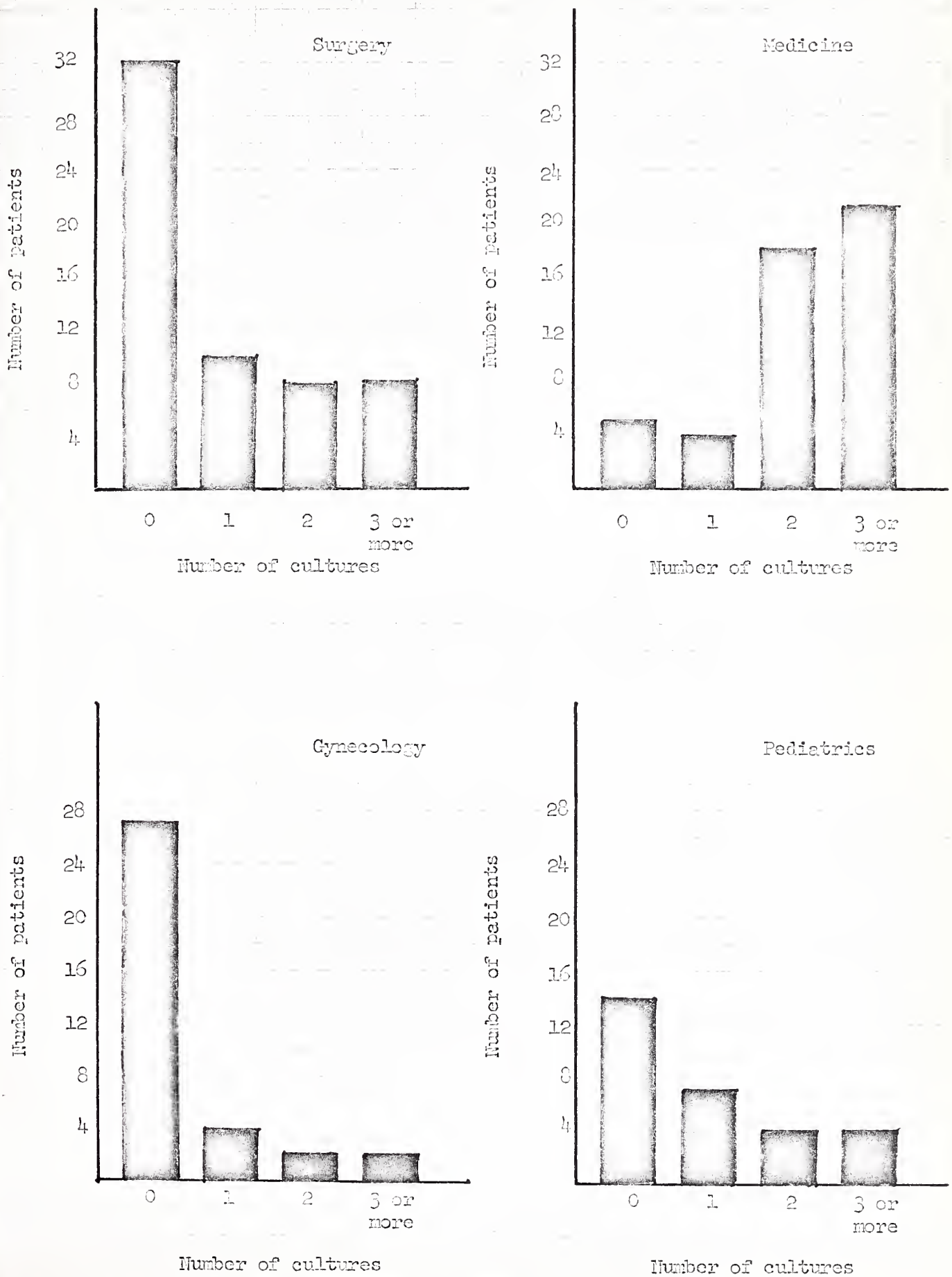
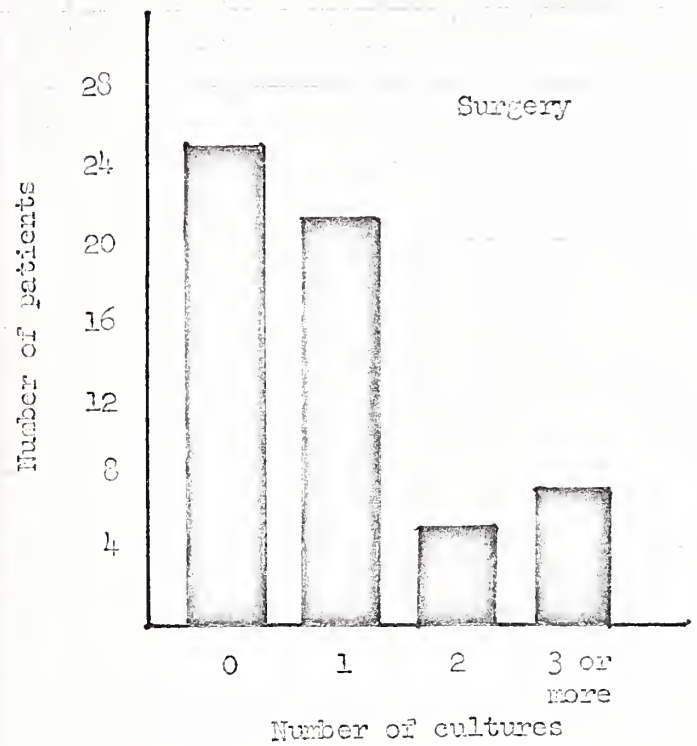
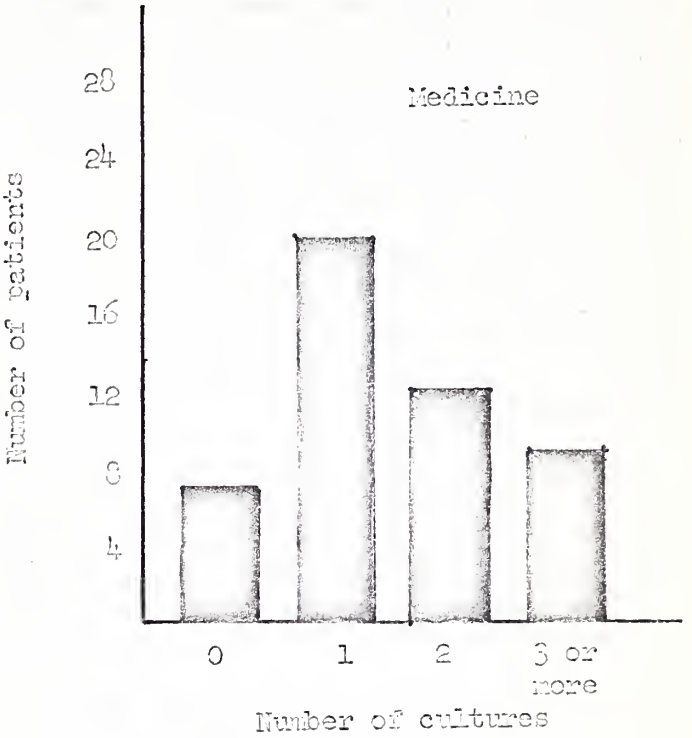
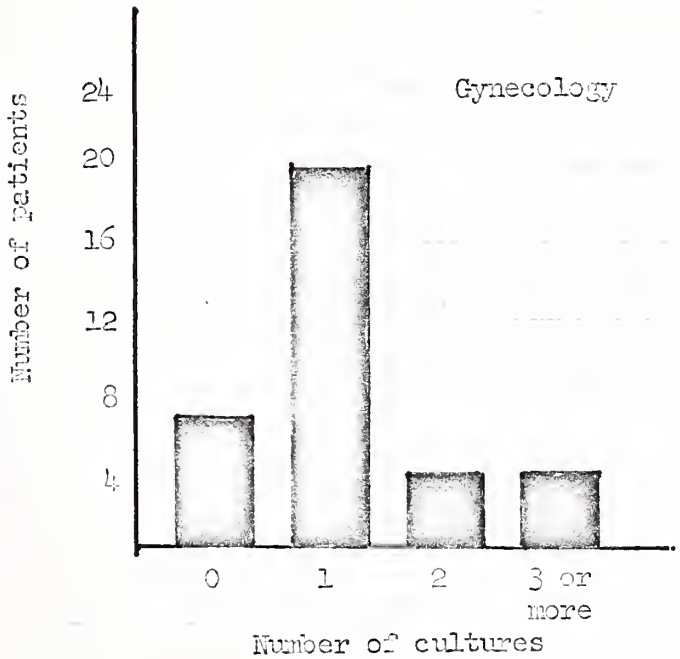


FIGURE 12 Urine Cultures







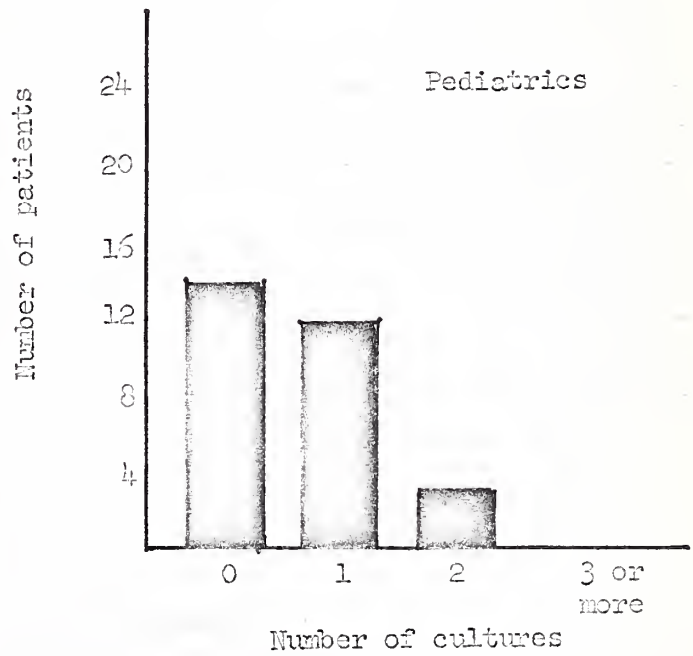
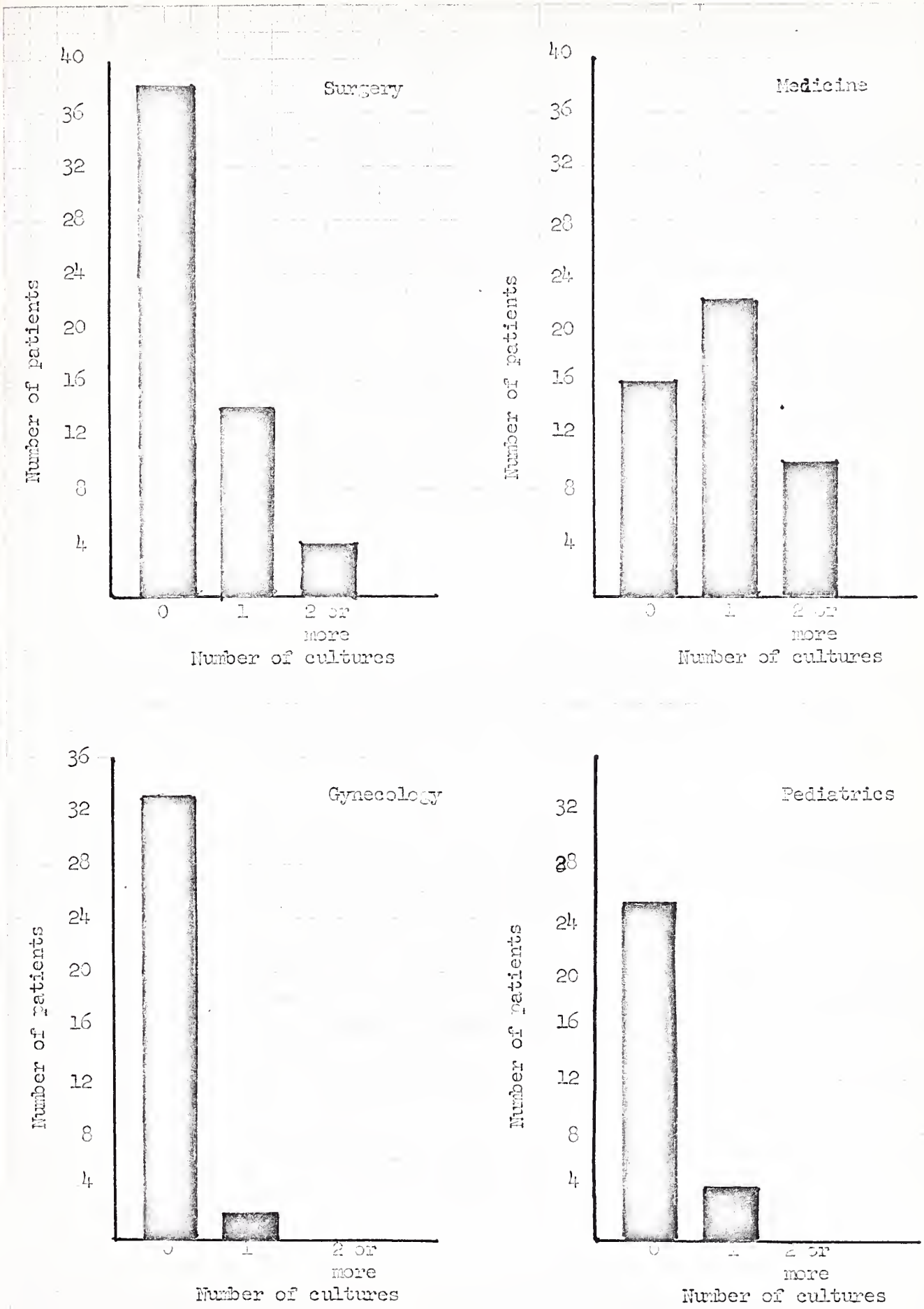
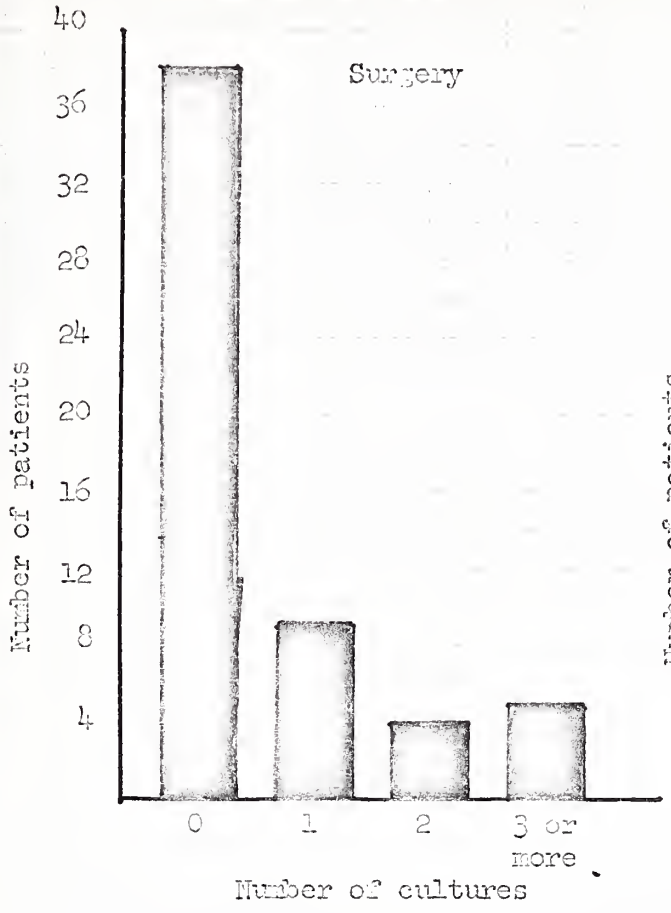
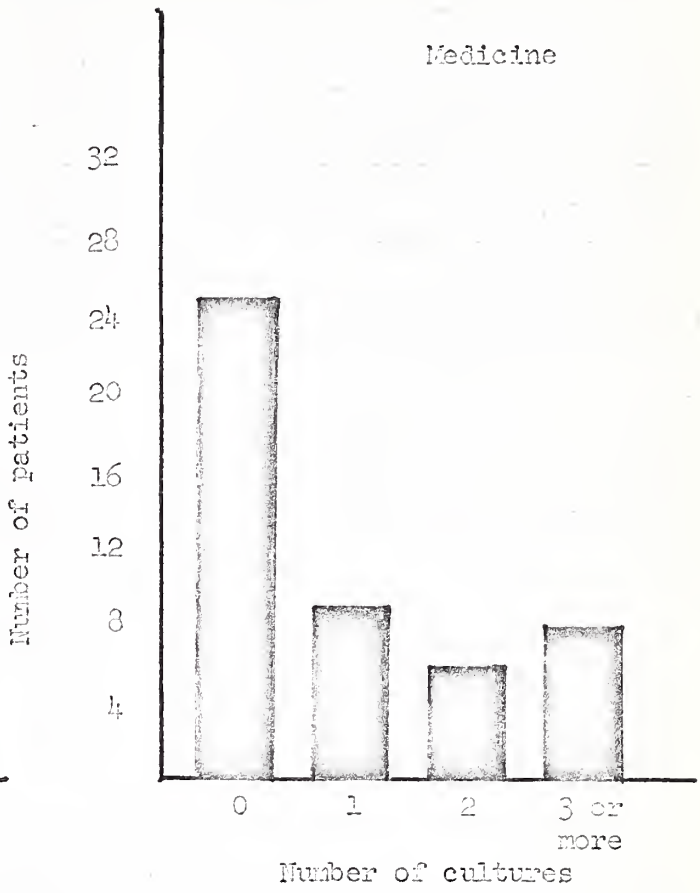
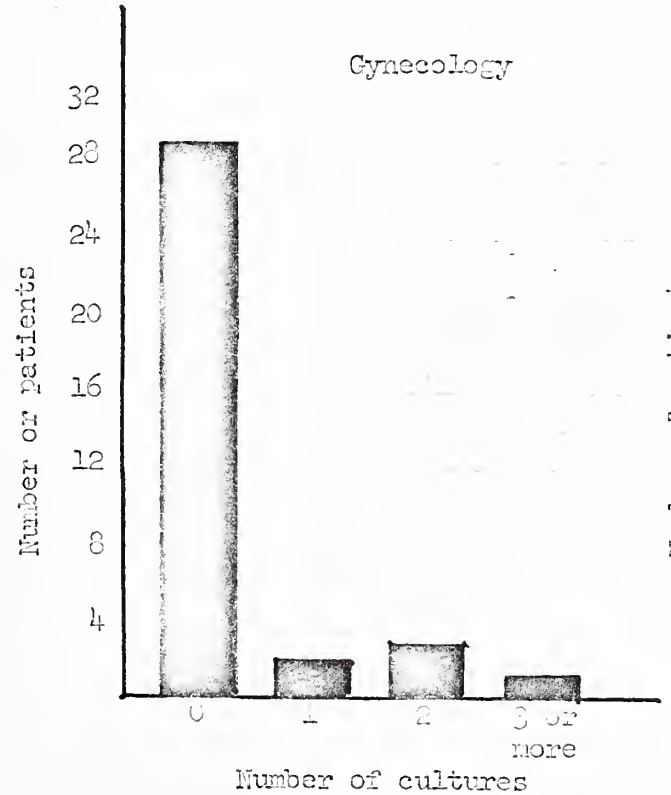


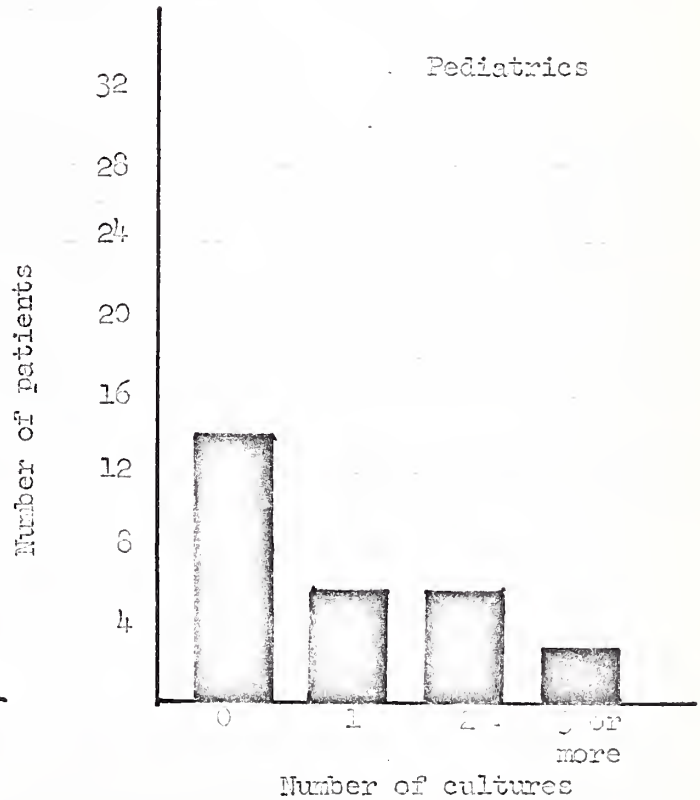
FIGURE 13 Sputum Cultures




Surgery
Number of patients
40
36
32
28
24
20
16
12
8
4
0
1
2
3 or more
Number of cultures


Medicine
Number of patients
32
28
24
20
16
12
8
4
0
1
2
3 or more
Number of cultures


Gynecology
Number of patients
32
28
24
20
16
12
8
4
0
1
2
3 or more
Number of cultures


Pediatrics
Number of patients
32
28
24
20
16
12
8
4
0
1
2
3 or more
Number of cultures

ordering one or more such cultures on 48% of patients whose fever was noted; surgery, 32%, gynecology, 17%, and pediatrics, 52%.

Comparative ordering of other diagnostic tests is shown in Figure 15. Again, only patients whose fevers were noted in doctor's progress notes were considered. White blood cell counts were done on most patients with noted fevers: 94% of surgical, 92% of medical, 86% of gynecological, and 76% of pediatric patients. Inter-service differences were significant to the .05 level. Fewer patients received urinalyses: 75% of medical, 47% of surgical, 71% of gynecological, and 66% of pediatric patients with fevers. Difference again is significant to the .05 level. There was much more variation in the use of the sedimentation rate; usage ranged from 45% of medical to 12% of surgical to 20% of gynecological to 38% of pediatric patients with noted fevers. The use of xrays also varied widely, from 79% of medical to 56% of surgical to 27% of gynecological to 52% of pediatric patients. Medicine also requested the most infectious disease consults. 26% of medical patients with recognized fevers were seen by the infectious disease service, while only 7% of pediatric, 5% of surgical, and no gynecological patients were seen by the infectious disease service. These inter-service differences are highly significant ($p < .005$).

Such wide variations did not occur from service to service on checking intravenous and Foley catheters, in that very few patients on all services were examined at

FIGURE 15 Use of Diagnostic Tests

	WBC	Differ-ential	ESR	UA	Xrays	ID consult
Surgery	94% (53/56)	93% (52/56)	12% (7/56)	47% (27/56)	56% (32/56)	5% (3/56)
Medicine	92% (44/48)	90% (43/48)	45% (22/48)	75% (36/48)	79% (38/48)	26% (13/48)
Gynecology	86% (30/35)	66% (23/35)	20% (7/35)	71% (25/35)	27% (9/35)	0% (0/35)
Pediatrics	76% (22/29)	76% (22/29)	38% (11/29)	66% (19/29)	52% (15/29)	7% (2/29)

their intravenous catheter sites. (These data pertain to both patients whose fevers were noted, and those whose fevers were not noted.) Of the 54 surgical patients with IV's during their febrile episodes, the IV's of only 2 were commented on in the progress notes as having been checked. Similarly, only 2 of the 30 medical, 1 of the 32 pediatric, and none of the 29 gynecological patients with intravenous drips had their catheter sites checked as the possible source of the fever. These inter-service differences were not significant. However, the various services were equally careful about checking Foley catheters. Surgeons obtained urine cultures on 13 of 15 patients with such catheters; medicine, on 7 of 9 patients, and gynecology, on 15 of 20 patients; no pediatric patients had Foley catheters during their febrile episodes. These inter-service differences are not significant.

All services were equally careful to discharge very few patients with fevers. One febrile surgical patient was transferred to another hospital; one medical patient was transferred to a nursing facility. One pediatric patient was transferred to the infirmary of a prepaid health plan; another, with a malignancy, was discharged to home. Similarly, of the gynecological patients, one was sent to a nursing facility; another, with fever thought secondary to tumor, was sent home. All other patients were afebrile at time of discharge.

Although the data on the average length of hospitalization

of the nonfebrile patients on the services surveyed is not available, the data on the average length of stay of the febrile patients is available. This data can be compared to the average length of stay of all patients hospitalized on the various services during the period from October 1972 to September 1973, available in the annual report of this hospital. For all services, the hospital stay of febrile patients in this study exceeded the average hospital stay for patients on that service in general. Among the surgical patients in this study, the average stay was 16.0 days, median stay 13 days, with a range from 1 to 66 days. The average stay of general surgery patients, from the annual report, is 10.3 days. Medicine patients in this study stayed an average of 22.8 days, with a median of 17 days, and a range of from 2 to 111 days. The average stay of medicine patients in this hospital is 10.4 days. The febrile pediatrics patients in this study stayed an average of 10.8 days, median of 6, range from 1 to 84 days. The average pediatrics patient in the surveyed center stayed 6.0 days. And the average stay of febrile gynecology patients in this study was 10.8 days, median, 8 days, range, from 2 to 34 days. The average gynecology patient in the hospital report stayed 4.2 days. However, this last comparison may be somewhat misleading in that most gynecology patients hospitalized for short stays (for tubal ligations, dilatation and curettages, etc.) are not hospitalized on the gynecology

ward included in this study.

And although services may differ significantly on the use of different diagnostic aids, they do not differ significantly on one aspect of treatment, that is, antibiotic usage. The variation among antibiotic usage in patients during noted febrile episodes ranged from 65% on the medical services, to 57% on both the surgical and gynecological services, to 48% on the pediatric service; inter-service differences are not significant.

DISCUSSION

How then may we summarize and generalize this information? On any one day, approximately 30% of the patients in hospital on the major services in this sample had a fever, as defined as an oral temperature of 100.4°F or greater. Likewise, 30% of all patients admitted to the major services in this study were admitted with or at one time during their hospitalization developed such a temperature elevation. Therefore, fever, as defined above, would seem to be a relatively common phenomenon at a major university medical center. And from this data it seems to be most common on the surgical services, with 40% of the patients so affected. And as was previously noted about acquisition of infections, fewer surgical than medical entered with their fevers (37% vs. 45%).

Having established that fevers are common, what is done about them? Most are at some point noted by those taking care of the patient. However, a significant number

(over one third of pediatric and over one quarter of surgical, and a tenth of medical and gynecological fevers) are not ever noted in the doctor's progress notes. The fevers that are noticed are noted fairly shortly after they develop; average delay amounting to less than half a day.

One may ask then if there was something about the unnoted fevers which made them appear less significant to the person caring for those patients. They certainly were of lesser peak temperatures: only one patient in this study whose temperature exceeded 102°F orally was not noted as being febrile. And in retrospect, those fevers which were not noted were of shorter duration, lasting only two days in comparison to the four to six days average duration of noted fevers on the various services. However, fever workups are not done in retrospect, but are done in less than one day after the temperature is first elevated. And on those services on which a large portion of the fevers were not noted, namely surgery and pediatrics, the workups of the noted and unnoted fevers proceeded differently. It should be noted here, however, that the definition of fever as used in this paper refers to an adult population, and that what pediatricians in this center consider a fever may be in general higher than the level defined for adult patients. "Some clinicians are convinced that an impressive case can be made for not treating moderate and low grade elevations of temperature per se (< 102°F)." (Cone, 1969)

Once a fever is noted, however, the workups still

proceed differently on different services. Of such patients hospitalized on medical services, two or more blood cultures were drawn on over 80%, while less than 30% of the patients hospitalized on all other services investigated had two or more blood cultures taken. Only the gynecology service ordered a number of urine cultures comparable to the number taken on the medical service. The medical service also ordered many more sputum cultures (on two thirds of all patients recognized as being febrile) than all other services (less than one third of such patients). Even allowing that only cultures specifically indicated should be taken for study (e.g. wound, if the incision site looks at all infected), the surgery and gynecology services took such cultures on less than one third of their patients with noted fevers. A large number of the "other" category of pediatric cultures were throat cultures which on pediatric services may be of more value than sputum cultures.

One may say though that the house staff was being economical, and after noting the fevers and thoroughly examining the patient they decided that the fever was most likely not of bacterial origin. Certainly there are many other causes of fevers besides infections; it is obvious simply from statistics that the percentage of patients who developed "nosocomial" fevers in this study is approximately 20%, whereas the hospital infection rate is near 7% (Hierholzer, personal communication). One must speculate that 13% of the patients in this study had viral syndromes

(Howard, 1973), atelectasis (Ledger, 1972), or some other non-bacterial cause of their fevers. However, one must then ask the question that if the suspicion of infection was so low on certain services, why was the use of antibiotics so high? Antibiotics are far from benign drugs. "None of the presently available antimicrobial drugs is free of the potential for producing untoward effects. The list of undesirable reactions is long and varied." (Weinstein, 1970) The usage of antibiotics in febrile patients did not differ significantly among the different services, and ranged from 48% on the pediatric service to 65% of the patients on the medical services. And although the authors of this quote were referring to classic fevers of unknown origin, their sentiments have been echoed by others:

> Therapeutic trials must never be substituted for thorough investigation of fever of obscure origin. The empiric use of antimicrobial agents or corticosteroids, or both, is not only dangerous because of the risk of serious reactions but may also be misleading because fall of temperature may be purely fortuitous...The experienced clinician knows that in many instances, a therapeutic response has no diagnostic significance. (Molavi, 1970)

There are of course many other means available to work up a fever. Most patients, on all services, did receive white blood cell counts, and a majority did receive urinalyses (which are tests which incidentally require little time effort from house staff, being drawn by nurses and technicians). However, there was wide variation among use of the sedimentation rate, xrays, and infectious disease consults, again with the medicine service orderingsuch tests for the

largest proportion of febrile patients. Yet many sources advocate use of the ESR in evaluation of gynecological problems, as in the evaluation of pelvic inflammatory disease (Kistner, 1971), or in the evaluation of surgical problems, such as osteomyelitis. Advocates of xray ordering in surgical patients have already been discussed.

None of the services availed themselves of checking one possilbe fever source: the intravenous site. Although all the services seemed cognizant of the fact that many patients with indwelling urethral catheters acquire bacteriuria (Garibaldi, 1974), they in general ignored the possibility of infection secondary to intravenous therapy. Yet such infection has been shown to be a real risk, both at other institutions (Maki, 1973; Altemeier, 1971), and at the institution studied in this paper (Smits, 1967). IV sites should be particularly inspected if the catheter has been in place for over 48 hours, as 2 to 8% of such catheters lead to sepsis, or if the IV has been placed by the house officer, and not the IV team, as 90% of patients with sepsis secondary to intravenous therapy had catheters placed by house officers. (Maki, 1973) Perhaps house officers ought to pay more attention to catheters, because though the IV team places most of the catheters, they do not culture these catheters, nor do they record their observations in the doctor's progress notes.

Having demonstrated that there are differences in fever workups, can a case be made for standardization of

the approach to a fever? Certainly the person examining the patient is the best judge of how sick the patient appears. If the patient does not appear septic, but in fact appears, from history and careful physical exam, to be suffering from atelectasis or a viral syndrome, perhaps cultures are not indicated and the patient should simply be followed carefully. However, if any patient appears septic enough to warrant antibiosis, as seemed to have been deemed the case in over half the recognized febrile patients in this study, certain cultures and tests would be helpful in identifying the fever source. I shall return to Feller's recommendations: chest xray, urine culture, two blood cultures, white blood cell count, and any appropriate wound, drain, tracheal, and spinal fluid cultures. And although recommended by a surgeon, the medicine services seem to be the only ones following such a regimen. It may be expensive: at this institution, a chest xray costs $19, white blood cell count with differential count, $5, and cultures cost $6 each. But even on purely economical grounds, if such an approach speeds recovery by even one day, it is still worth it: the average cost per day for a semi-private room in this institution is $108, while the average daily cost to a patient is $175. Data from this study suggest that febrile patients stay in hospital many more days than the general patient on the services that were sampled. If all tests are negative, the patient has

perhaps been saved subjection to unnecessary antibiotics. Therefore, to quote one very old scientist, "Si vous gagnez, vous gagnez tout, et si vous perdez, vous ne perdez rien." (Pascal, 1670) If you win, you win everything, and if you lose, you lose nothing.

BIBLIOGRAPHY

Allen, J.E., Rampone, J.F., Wheeliss, C.R.: Use of a prophylactic antibiotic in elective major gynologic operations. Obstet. Gynec. 39: 218-224, 1972.

Altemeier, W.A., McDonough, J.J., Fullen, W.D.: Third day surgical fever. Arch. Surg. 103: 158-166, 1971.

Altemeier, W.A.: Changing patterns in surgical infections. Ann. Surg. 178: 436-445, 1973.

Atkins, E. in Macbryde, C.M., Blacklow, R.S. Signs and Symptoms; applied pathologic physiology and clinical interpretations. Philadelphia, Lippincott, 1970.

Atkins, E., Bodel, P.: Fever. N. Engl. J. Med. 286: 27-34, 1972.

Barrett, F.F., Casey, J.I., Finland, M.: Infections and antibiotic use among patients at Boston City Hospital. N. Engl. J. Med. 278: 5-9, 1968.

Brachman, P.S., Eickhoff, T.C., eds.: Proceedings of the International Conference on Nosocomial Infections, Center for Disease Control, August 3-6, 1970. Chicago, American Hospital Association, 1971.

Cimochowski, G.E.: Sepsis and sloppy surgery. Ann. Int. Med. 78: 302-303, 1973.

Cone, T.E.: Diagnosis and treatment: children with fevers. Pediatrics 43: 290-293, 1969.

Dalton, H.P., Allison, M.J.: Etiology of bacteremia. Appl. Microb. 15: 808-814, 1967.

Dineen, P.: Laboratory diagnosis of surgical infections. Surg. Clin. N. Am. 52: 1379-1383, 1972.

Eickhoff, T.C., Brachman, P.S., Bennett, J.V., Brown, J.F.: Surveillance of nosocomial infections in community hospitals. I. Surveillance methods, effectiveness, and initial results. J. Infect. Dis. 120: 305-317, 1969.

Faris, I. Temperature chart analysis in the diagnosis of deep vein thrombosis. Am. Heart J. 87: 259-260, 1974.

Feingold, D.S. Hospital acquired infections. N. Engl. J. Med. 283: 1384-1391, 1970.

Feller, I. Diagnosis of surgical infections. Surg. Clin. N. Am. 52: 1391-1398, 1972.

Garibaldi, R.A., Burke, J.P., Dickman, M.L., Smith, C.B.: Factors predisposing to bacteriuria during indwelling urethral catheterization. N. Engl. J. Med. 291: 215-219, 1974.

Habel, A.H.: Premature rupture of membranes and effects of prophylactic antibiotics. Arch. Dis. Child. 47: 401-404, 1972.

Hanninen, P.: Septicimia in a pediatric unit. A 20 year study. Scand. J. Infect. Dis. 3: 201-208, 1971.

Hector, W.E.: A talk to student nurses. I. Changes in the temperature. Nurs. Times 64: 353-354, 1968.

Hibbard, L.T.: Sexual sterilization by elective hysterectomy. Am. J. Obstet. Gyncecol. 112: 1076-1083, 1972.

Howard, R.J.: Viral infections and the surgical patient. Surg. Gynecol. Obstet. 137: 1029-1046, 1973.

Jansson, E.: A 10 year study of bacteremia. Scand. J. Infect. Dis. 3: 151-155, 1971.

Kistner, R.W.: Gynecology, principles and practices. Chicago, Year Book Medical Publisher, 1971.

Ledger, W.J.: Infections in obstetrics and gynecology. Surg. Clin. N. Am. 52: 1447-1458, 1972.

Ledger, W.J., Reite, A., Headington, J.T.: The surveillance of infection of an inpatient gynecology service. Am. J. Obstet. Gynecol. 113: 662-671, 1972.

Ledger, W.J., Kriewall, T.J.: The fever index: a quantitative indirect measure of hospital acquired infections in obstetrics and gynecology. Am. J. Obstet. Gynecol. 115: 514-520, 1973.

Lewin, E.B.: Detection of bacteremia. J. Infect. Dis. 125: 325, 1972.

Macbryde, C.M., Blacklow, R.S. Signs and Symptoms; applied pathologic physiology and clinical interpretations. Philadelphia, Lippincott, 1970.

Maki, D.G.: Infection control in IV therapy. Ann. Int. Med. 79: 867-887, 1973.

McGowan, J.E.: Bacteremia in febrile children seen in a walk-in pediatric clinic. N. Engl. J. Med. 288: 1309-1312, 1973.

Molavi, A., Weinstein, L.: Persistent perplexing pyrexia: Some comments on etiology and diagnosis. Med. Clin. N. Am. 54: 370-395, 1970.

Moody, M.C., Burke, J.: Infections and antibiotic use in a large private hospital. Arch. Intern. Med. 130: 261-266, 1972.

Nelson, W.E.: Textbook of Pediatrics. Philadelphia, W.B. Saunders, 1969.

Nissen, E.D., Goldstein, A.I.: A prospective investigation of etiology of febrile morbidity following abdominal hysterectomy. Am. J. Obstet. Gynecol. 113: 111-114, 1972.

Pascal, B.: Pensées. Paris, 1670.

Petersdorf, R.G., Beeson, P.B.: Fever of unexplained origin. Report on 100 cases. Medicine. 40: 1-30, 1961.

Petersdorf, R.G.: Physiology, pathogenesis, and diagnosis of fever. Med. Times. 96: 50-64, 1968.

Porges, R.F.: Vaginal Hysterectomy at Bellevue Hospital. Obstet. Gynecol. 35: 300-313, 1970.

Roe, C.F.: Benign post-op fever. Surg. Forum 21: 65-66, 1970.

Rosenfeld, C.R.: On the treatment of fever. J. Pediat. 78: 725-726, 1971.

Schwartz, S.I.: Principles of surgery. New York, McGraw-Hill, 1969.

Smith, A.L.: Childhood bacteremia. N. Engl. J. Med. 288: 1351-1352, 1973.

Smith, D.S.: Fever and the pediatrician. J. Pediat. 77: 935-936, 1970.

Smits, H., Freedman, L.R.: Prolonged venous catheterization as a cause of spesis. N. Engl. J. Med. 276: 1229-1233, 1967.

Snedecor, G.W., Cochran, W.G.: Statistical Methods. Ames, Iowa, Iowa State University Press, 1967.

Steele, R.W., Tanaka, P.T., Lara, R.P., Bass, J.W.: Evaluation of sponging and of oral anti-pyretic therapy to reduce a fever. J. Pediat. 77: 824-829, 1970.

Thoburn, R., Fekety, F.R., Cluff, L.E., Melvin, V.B.: Infections acquired by hospitalized patients-an analysis of the overall problem. Arch. Intern. Med. 121: 1-10, 1968.

Weinstein, L.: Chemotherapy of Microbial Diseases. in Goodman, L.S., Gilman, A.: The Pharmacologic Basis of Therapeutics. New York, The Macmillan Company, 1970.

Weinstein, L.: Infective endocarditis-1973. Prog. Cardiovasc. Dis. 16: 239-274, 1973.

Wise, R.I.: Fever in the post-op period. Amer. J. Cardiol. 12: 475-476, 1963.

Wohl, L.S.: Bacteremia: prevention and detection. N. Engl. J. Med. 290: 162-163, 1974.

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